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CARBON DIOXIDE AS A PROPELLENT FOR INSECTICIDE SOLUTIONS[6/]

By R. A. Fulton,
Division of Insecticide Investigations

The liquefied-gas aerosols in common use contain approximately 80 percent of Freon-12 (dichlorodifluoromethane) as the propellent, and usually 2 percent of pyrethrum extract (containing 20 percent of pyrethrins) and 3 percent of DDT. They are formulated for the treatment of enclosed spaces, and leave no appreciable deposit of DDT on ceilings and vertical surfaces. However, if the percentage of nonvolatile material in the aerosol is increased by the addition of acetone or other organic solvents, a coarse mist is produced which will adhere to all types of surfaces. The liquefied gas Freon-12 has a vapor pressure of approximately 85 pounds per square inch (gage) at room temperature. When the content of nonvolatile materials is increased to 50 percent, the pressure is reduced approximately one half, or to 40 pounds per square inch. This reduced pressure is insufficient to carry the particles more than 24 inches. A study has therefore been made of the use of carbon dioxide to increase the pressure of the solution and thus make the mist effective for greater distances, and to decrease the cost of the solution by reducing the Freon content. Tests are now being conducted in greenhouses, on field crops, and on treated surfaces in the laboratory to determine the advantages and disadvantages of this method of applying organic insecticide deposits.

A number of formulas, in which carbon dioxide has been added to various solvents and organic insecticides, have been tested to determine the most effective combination for the particular type of surface being treated. Two typical formulas are as follows (figures in percent):

Component	G-496	G-470
DDT (aerosol grade)	10	9.5
Cyclohexanone	10	—
Velsicol AR-60 (chiefly di- and tri-methylnaphthalenes)	10	9.5
Acetone	65	28.6
Methylene chloride (technical)	—	47.6
Freon-12	5	4.8

Carbon dioxide is added to bring the pressure to 150 pounds per square inch.

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Formula G-496 leaves an oily deposit on nonabsorbent surfaces, but on foliage and other absorbent surfaces the deposit soon becomes white. The deposit from formula G-470 is white soon after the droplets contact any type of surface.

Formula G-496 absorbs 13.6 grams of carbon dioxide per 100 grams of solution, whereas G-470 absorbs only 7 grams. If a solution is discharged on a weight basis, a correction must be made for the increase in weight due to the absorbed carbon dioxide.

The carbon dioxide-propelled insecticide solutions are prepared in the manner described for the Freon-12 types (Goodhue and Sullivan 1, Fulton et al. 2), except for the addition of the carbon dioxide. The container is washed with dry acetone and evacuated. The DDT is dissolved in the solvents and filtered, and the weighed solution is then drawn into the container through a copper-tube connection. The container is connected to the Freon-12 supply, filled with the desired weight of the liquefied gas and then connected to a liquid carbon dioxide tank equipped with a reducing valve and gage. The valve is set for 180 pounds per square inch pressure. The gas is allowed to bubble through the solution by holding the container in an inverted position. As considerable heat is generated within the container while it is being filled with carbon dioxide, it is necessary to cool it in water at approximately 65° F. The reducing valve is then set for 150 pounds, and as soon as the container has cooled it is shaken until no more gas passes through the reducing valve. The container is then ready to be connected to an oil-burner nozzle for use.

The delivery rates of the two formulas through different-sized nozzles are shown in table 1. The rate of flow for formula G-496 is constant, whereas for formula G-470 it decreases approximately 10 percent while the container is being emptied.

Table 1.--Discharge rates and amount of DDT deposited by two solutions containing carbon dioxide as propellent, when discharged through oil-burner nozzles of different sizes.

Size of nozzle (Gallons per hour)	Rate of discharge (Grams per second)		DDT deposit (Milligrams per square foot)	
	Formula G-496	Formula G-470	Formula G-496	Formula G-470
1.35	1.15	1.26	45	42
1.65	1.62	1.73	52	47
2.00	1.80	2.00	70	65
2.50	2.27	2.33	73	71
3.00	2.51	2.53	84	79
4.00	3.12	3.33	112	105
5.00	3.6	4.26	155	140

When carbon dioxide is used as the principal propellent, the rapid drop in pressure is eliminated by the addition of a small percentage of Freon-12.

The deposits of DDT obtained on glass plates suspended approximately 16 inches from the oil-burner nozzles are also shown in table 1. The container was moved at the rate of 1 foot per second, at which rate there was no dripping on the glass surfaces.

Carbon dioxide appears to be a satisfactory propellent for insecticide solutions containing DDT. The characteristics of the mists produced are such that they may be used as space sprays or as residual sprays for protection against crawling insects. Preliminary field tests against the pea aphid indicate that solutions propelled with carbon dioxide are more efficient than those depending entirely upon Freon-12 or methyl chloride.

Literature Cited

(1) Goodhue, L. D., and Sullivan, W. N.
1942. The preparation of insecticidal aerosols by the use of liquefied gases. U. S. Bur. Ent. and Plant Quar. ET-190, 3 pp. [Processed.]

(2) Fulton, R. A., Berlin, F. D., and Bochert, R. S., Jr.
1947. A laboratory method for filling aerosol containers. U. S. Bur. Ent. and Plant Quar. ET-245, 2 pp. [Processed.]